and vegetable life are so associated there is a more vigorous development and more early maturing of the fungus than under ordinary circumstances. Let us hear from others on this interesting subject.

TREATMENT OF APPLE SCAB.

By B. T. GALLOWAY and E. A. SOUTHWORTH.

In May of last spring arrangements were made with the experiment stations of Michigan and Wisconsin to carry on a series of experiments for the purpose of finding a remedy for Apple Scab (*Fusicladium dendriticum*, Fckl.).

The fields of experiment were located at Lansing, Mich., on the College Farm, and at Ithaca, Richland County, Wis.; the work at the former place being under the direction of Professor Taft, Horticulturist of the College and Experiment Station, and at the latter under the general supervision of Professor E. S. Goff, Horticulturist of the Wisconsin Experiment Station, and in direct charge of Mr. A. L. Hatch, of Ithaca.

The season was a favorable one, as the weather was wet enough to favor the growth of the fungus and thus offered a fair test of the remedies employed.

The plan of work was drawn up at this Department and the same outline for the experiments was given to both. The instructions were very carefully carried out, and both experimenters have been unremitting in their diligence in making the applications and preserving accurate accounts of the results.

The fungicides used were sulphide of potassium, hyposulphite of soda, a soluble sulphur powder prepared by Mr. E. Bean, Jacksonville, Fla., ammoniacal solution of copper carbonate, and modified eau celeste. Professor Goff, however, did not use the eau celeste.

Both made seven applications; Professor Goff beginning May 18, and Professor Taft May 24, when the apples were about the size of peas and before any trace of scab was apparent. In regard to the time of beginning, Mr. Hatch says he is convinced that the applications should be started earlier, as he thinks fungus activity begins with the swelling of the buds. The varieties treated were the Northern Spy, by Professor Taft, and the Fameuse, by Professor Goff; both selected because they had been particularly troubled by scab previous to the present year.

With regard to the strength of the solutions employed, Professor Taft and Professor Goff both used the potassium sulphide in the proportions of one-half ounce to the gallon of water. The hyposulphite was used in both cases at the rate of 1 pound to 10 gallons. Professor Goff records some injury to the leaves from this strength, and on the fifth applica-

tion Professor Taft reduced the solutions, using 1 pound to 12 gallons, after which he says there was no further injury to the foliage.

The soluble sulphur powder was used in the proportion of 1 pound to 10 gallons of water, but Professor Taft was not able to make the first application until June 6. Mr Bean also sent Professor Goff a concentrated solution of the powder, which was diluted and used for three applications to two trees, after which he was obliged to stop because he had exhausted the supply and received no more.

The copper carbonate was prepared differently by the two. Professor Taft used the usual formula, 3 ounces of copper carbonate dissolved in 1 quart of ammonia and the whole diluted to 22 gallons. It was used at this strength throughout the experiment, but produced a russet appearance on the fruit, and he recommends that it should be diluted to 28 instead of 22 gallons.

Professor Goff procured the copper carbonate by precipitating it with carbonate of soda from a solution of copper sulphate. He found that only $1\frac{1}{3}$ ounces of the dried precipitate would dissolve in 1 quart of ammonia, and to this he added 90 parts water. At the sixth spraying (July 24) he observed that the apples had assumed a russet appearance from some injury to the epidermis. For the sixth and seventh spraying he reduced it one-half, that is diluted it 180 times.

Professor Taft prepared the eau celeste as follows: He dissolved 2 pounds of copper sulphate in hot water, and in another vessel dissolved $2\frac{1}{2}$ pounds carbonate of soda; the two were mixed and diluted to 22 gallons, $1\frac{1}{2}$ pints of ammonia being added before using. This also gave a russet appearance to the fruit, and he recommends the use of 30 or 32 gallons of water instead of 22.

On the sixth application Professor Taft only sprayed one tree with each solution, leaving one unsprayed in each case. He made the last application August 1, and Mr. Hatch made the last application for Professor Goff on August 10.

Results.—The copper solutions remained persistently on the leaves, even resisting heavy showers which washed off all traces of the sulphur compounds, and when the leaves fell in October traces of copper could still be seen on them.

Scab was first noted at Lansing on the fourth application, June 25, when it had made its appearance on all the trees, but was noticeably less on those sprayed with the copper solutions, and less on the other treated trees than on the untreated ones.

At time of harvesting Professor Taft picked all the apples on the trees and assorted them into three lots, of first, second, and third quality. The first class contained those free from scab, the second those slightly scabby but not distorted or under size, the third those that were distorted or under size. Those in each class were counted and the percentage which they formed of the whole estimated.

At Ithaca, Wis., the apples were not all picked, but a market-basket

holding about 1½ pecks was first filled with apples from the lowest branches of one of the trees. Next a similar basketful was picked from the branches that were just the height one could conveniently reach, taking care to pass clear around the tree in both cases. After this a basket of one-half a bushel was filled from the tallest branches of the tree. The apples were then poured upon an assorting table; and the baskets filled and emptied again in the same manner and from the same tree, after which the contents of the six basketfuls were assorted into three qualities as in the preceding case.

The results in both cases are embodied in the following table:

	Professor Goff's experiments.					Professor Taft's experiments.					
	Applications.	Free from scab.	Slightly scabby.	Badly scabby.	Cost per tree.	Applications.	Free from scab.	Slightly scabby.	Badly scabby.	Cost per tree.	Total yield.
		Per cent.	*Per cent.*	*Per cent.*	*Cts.*		*Per cent.*	*Per cent.*	*Per cent.*	*Cts.*	*Pounds.*
Potassium sulphide	7	30.04	48.55	21.41	37	7	25.5	74.3	.2	39	1,615¼
Sodium hyposulphite	7	43.24	42.78	13.98	29	7	23.6	75.4	.89	23	1,648
Sulphur powder	7	32.72	54.31	12.97	31	6	17.6	81.2	1.1	31	1,435¼
Am'l copper carbonate	7	75.02	23.35	1.63	38	7	51.2	48.6	.16	49	2,112¾
Eau celeste	.....	.....	.....	.....	.....	7	68.8	31.0	.2	60	1,675½
Sulphur solution	3	42.9	48.99	8.11	.....	.....	.....	.....	.....	.....	.....
Unsprayed	.....	23.34	53.89	22.71	.....	.....	12.5	85.7	1.8	.....	769¼

It will be seen that at both places there is a very decided showing in favor of the copper solutions. Professor Goff did not try the eau celeste, and this produced the best results for Professor Taft, giving 68.8 per cent. entirely free from scab. One of the trees produced 88 per cent. free from scab, the other was heavily loaded and gave 59 per cent. The two sets of results agree as to the main point but show some striking differences. It is probable that these are partly owing to different localities, varieties treated, and varying conditions of weather, and very likely in great measure to different ideas of the two experimenters as regards the three classes into which the apples were assorted. In many cases it would be a question as to which of two classes an apple should belong.

By comparing the two tables it is evident that the badly scabby apples were more numerous in Mr. Hatch's orchard, while those of the second quality preponderated on the college farm.

Professor Goff obtained the best results with the ammoniacal copper carbonate solution, thereby keeping 75.02 per cent. free from scab against 51.2 per cent. by Professor Taft. There is, however, about the same per cent. of badly scabby apples in both cases. Professor Goff's results with this are even better than Professor Taft's with eau celeste, except that the badly scabby apples were over 1 per cent. greater with the

former. The most striking difference in the results, however, is in case of the sulphur powder. With Professor Goff it ranked ahead of the potassium sulphide, and as regards amount of badly scabby apples, ahead of the sodium hyposulphite, while with Professor Taft it fell behind both. The solution of the powder which was prepared by Mr. Bean, although applied but three times, completely preserved 42.9 per cent. of the fruits from scab against 23.34 per cent. on the unsprayed trees, a very good showing under unfavorable conditions. With Professor Goff sodium hyposulphite succeeded better than potassium sulphide, while the contrary was true with Professor Taft, although the difference is not marked in either case.

Aside, however, from these minor differences, it is evident from the tables that the sprayed trees, especially those sprayed by copper compounds, produced a much larger percentage of healthy fruit than the unsprayed. The greatest difference between the perfect fruit on sprayed and unsprayed trees under Professor Goff's charge was 51.68 per cent. and the least 6.7 per cent. The greatest difference in those under Professor Taft's charge is 56.3 per cent. and the least 5.1 per cent., the two results being essentially the same.

Besides the tabulated results there were others which are of great importance but can not be estimated in exact figures. A scabby apple is much smaller than a healthy one, and in many cases, while the apples could not be placed in class one, the scab had so been held in check that the fruit had obtained a greater size than it otherwise would. Professor Taft gives the difference in weight between perfect and scabby fruits as varying from .037 to .002 pound for each apple, and says the scabby apples are 10 per cent. smaller than the perfect ones, making a difference of nearly a bushel per tree in size alone, besides the fact that the apples that are badly scabby are unmarketable. "From the combined effect of the two causes," he says "we lost on some trees a barrel of apples."

The cost of the chemicals and labor expended varied but slightly in the two cases, but both gentlemen were obliged to buy chemicals in small amounts, and the cost per tree would be greatly lessened by treating a large orchard and buying materials in quantity. Professor Taft used large trees requiring 3 gallons each for each application, while Professor Goff used 3 gallons for the two trees, but Professor Goff estimates the labor higher than Professor Taft, and this makes the figures nearly alike. Both these estimates, however, are for seven applications. In an average season, and with the copper solutions, four or at most five applications will probably be sufficient. It is likely that in a large orchard with average sized trees, when the chemicals were purchased by the quantity the expense could be reduced nearly one-half. The expense of the ammoniacal solution in particular would be reduced by purchasing the copper carbonate instead of preparing it from the sulphate.

In Mr. Goff's calculations the cost for labor in making the treatments amounts to more than half the expense.

It seems probable that it would be profitable to make the first application earlier than was done this year, and there is no reason why this application or the next should not be combined with London Purple or some other insecticide, and the tree protected from insects and fungi at the same time. Mr. Hatch closes his report thus:

What we now need is to determine the correct amount of the copper mixture to use, the times best suited to its application, and what combinations to make with insecticides, and a new era in fruit culture will be inaugurated.

NOTES.

By B. T. GALLOWAY.

POWDERY MILDEW OF THE BEAN.

Under date of December 13 Mr. C. N. McCallan, of St. George's, Bermuda, writes that on the 20th of November his section was visited by a very heavy fog, and a few days later he noticed that his crop of six-weeks beans was badly mildewed, the fungus being one of the *Erysipheæ*, probably *Erysiphe communis*, Lév. He immediately gave the plants a thorough dusting with flowers of sulphur, and in a week the fungus had entirely disappeared and the plants produced a good crop. Mr. McCallan was highly pleased with this result, as he has several times lost his entire crop of beans from the attacks of the same fungus. In this country, peas, especially those planted late in the season, are often attacked by mildew, which in all probability might be easliy prevented by the timely application of flowers of sulphur or some other fungicide. A powder made by mixing equal parts of air-slaked lime and flowers of sulphur will be found a very good remedy for this disease. The powder should be dusted on the foliage at the first appear ance of mildew and the operation repeated every ten or twelve days, or more often if there is an abundance of rain.

If one has a spraying machine a solution made by dissolving 3 ounces of carbonate of copper in 2 quarts of aqua ammonia diluted to 22 gallons will be found an efficient remedy against mildew. This solutiou should be applied every twelve or fifteen days, beginning at the first appearance of the disease. Three ounces of carbonate of copper can be bought for 10 cents, while the ammonia will cost about 10, making the total cost of the 22 gallons 20 cents; certainly a very cheap fungicide. If carbonate of copper is not obtainable it may easily be prepared by first dissolving sulphate of copper (blue stone) in water and then adding ordinary washing soda. The precipitate formed on the addition of the latter substance is carbonate of copper, and in order to obtain it the liquid only needs to be drawn off and the copper carbonate dried.